DENTAL MATERIALS 33 (2017) 1229–1243

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.intl.elsevierhealth.com/journals/dema

Impact of head and neck radiotherapy on the mechanical behavior of composite resins and adhesive systems: A systematic review

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ARTICLE INFO

Article history:
Received 12 April 2017
Received in revised form
12 July 2017
Accepted 13 July 2017

Keywords:
Radiotherapy
Composite resins
Adhesive systems
Head and neck neoplasms
Review

ABSTRACT

Objectives. To analyze the evidence regarding the impact of head and neck radiotherapy (HNRT) on the mechanical behavior of composite resins and adhesive systems.

Methods. Searches were conducted on PubMed, Embase, Scopus and ISI Web of Science databases using "Radiotherapy", "Composite resins" and "Adhesive systems" as keywords. Selected studies were written in English and assessed the mechanical behavior of composite resins and/or adhesive systems when bonding procedure was conducted before and/or after a maximum radiation dose ≥50 Gy, applied under *in vitro* or *in vivo* conditions.

Results. In total, 115 studies were found but only 16 were included, from which five evaluated the effect of *in vitro* HNRT on microhardness, wear resistance, diametral tensile and flexural strength of composite resins, showing no significant negative effect in most of reports. Regarding bond strength of adhesive systems, 11 studies were included from which five reported no meaningful negative effect when bonding procedure was conducted before simulated HNRT. Conversely, five studies showed that bond strength diminished when adhesive procedure was done after *in vitro* radiation therapy. Only two studies about dental adhesion were conducted after *in vivo* radiotherapy but the results were not conclusive.

Significance. The mechanical behavior of composite resins and adhesive systems seems not to be affected when *in vitro* HNRT is applied after bonding procedure. However, bond strength of adhesive systems tends to decrease when simulated radiotherapy is used immediately before bonding procedure. Studies assessing dentin bond strength after *in-vivo* HNRT were limited and controversial.

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http://dx.doi.org/10.1016/j.dental.2017.07.014
0109-5641/

Contents

1. Introduction

Head and neck radiotherapy (HNRT) produces a series of toxicities on non-targeted healthy tissues surrounding the tumor, leading to hyposalivation, mucositis, trismus, osteoradionecrosis and radiation-related caries [1–3]. The latter is marked by a rapid onset and a high potential for generalized dental destruction, affecting approximately 25% of the patients who concluded this treatment, which compromises the overall oral function and the quality of life of cancer survivors [4]. As a consequence, there's a strong recommendation for head and neck cancer patients to have their oral health monitored before, during and after radiotherapy.

In this context, contemporary protocols for oral conditioning in these patients include multiple dental restorations before and after HNRT [4–6]. In both situations, the choice of restorative materials is currently based on personal clinical experience rather than scientific evidence [7,8]. Due to the fact that dental restorations are in the same primary radiation field of the tumor, they would be also susceptible to the direct effects of HNRT. In fact, some *in vitro* studies have demonstrated a negative interaction between ionizing radiation doses and metallic dental materials, by increasing the original radiation dose due to their high density, atomic number and conductivity [9,10]. In addition, it has been observed that mechanical properties and clinical survival of restorative dental materials such as conventional glass ionomer and resin-modified glass ionomer cements are severely affected in an indirect way by hiposalivation related to radiogenic damage of salivary glands [11,12].

On this regard, non-metallic and insoluble dental materials are desirable to restore teeth from head and neck cancer patients before and after radiotherapy. Composite resins meet all these features, in addition they have excellent optical properties, elastic modulus similar to enamel and dentin which allows a more homogeneous masticatory load distribution. Also, these dental materials show higher biocompatibility compared to metallic restorations, as well as acceptable clinical performance [13]. Composite resins are used together with etch-and-rinse or self-etch adhesive systems, which permits a micromechanical, chemical or both approaches, promoting interaction with hard dental tissues [14]. These issues are relevant during restorative dental treatment in head and neck cancer patients who underwent or will undergo radiation therapy. In both cases, healthy dental tissue need to be preserved as maximum as possible and adequate bond strength is desirable, avoiding restoration replacement after cancer treatment has begun. However, as previously demonstrated in other studies, even using the most conservative HNRT techniques, tumor surrounding maxillofacial tissues and some restorative dental materials are directly or indirectly affected [10,11,15].

On this sense, it is possible to suggest that surface and bulk micromechanical properties of composite resins as well as bond strength of adhesive systems could be affected by HNRT as it occurs in enamel and dentin, especially when high doses of ionizing radiation are applied [16]. This phenomenon could impair tooth-restoration interaction, increasing the susceptibility to early restoration failure and radiation-related caries progression [17]. Unfortunately, until now no consensus exists regarding the direct and indirect effects of HNRT on